CLAIMS

What is claimed is:

1. A method, comprising:

adding a halogen substituted silicon hydride and a nitrogen-containing precursor to a first chamber;

applying a thermal energy to the halogen substituted silicon hydride and the nitrogen-containing precursor;

setting an operating temperature of the first chamber below 550 ^{0}C, and

depositing a silicon nitride layer on a substrate disposed in the first chamber at the operating temperature.

2. The method of claim 1, wherein adding further comprises pre-mixing the halogen substituted silicon hydride and the nitrogen-containing precursor in a second chamber coupled to the first chamber.

3. The method of claim 2, wherein the halogen substituted silicon hydride has the general formula:

$$SiH_aX_{4-a}$$

where *a* is an integer less than or equal to three and greater than or equal to one, and

X is a halogen.

4. The method of claim 2, wherein the halogen substituted silicon hydride has the general formula;

$$SiX_4$$

where X is a halogen.

5. The method of claim 2, wherein the halogen substituted silicon hydride has the general formula:

$$SiH_aX_bR_c$$

where *a* is an integer less than or equal to three and greater than or equal to zero,

where *b* is an integer less than or equal to three and greater than or equal to zero,

where *c* is an integer less than or equal to three and greater than or equal to zero,

where the sum of *a*, *b*, and *c* is equal to four,

where X is a halogen, and

where R is an alkyl group.

6. The method of claim 1, wherein adding further comprises reacting a halogen substituted disilicon hydride with a nitrogen source.

7. The method of claim 6, wherein the halogen substituted disilicon hydride has the general formula:

$$Si_2H_aX_{6-a}$$

where a is less than or equal to five and greater than or equal to one, and

where X is a halogen.

8. The method of claim 6, wherein the halogen substituted disilicon hydride has the general formula:

$$Si_2X_6$$

where X is a halogen.

9. The method of claim 6, wherein the halogen substituted disilicon hydride has the general formula:

$$Si_2H_aX_bR_c$$

where *a* is an integer less than or equal to five and greater than or equal to zero,

where *b* is an integer less than or equal to five and greater than or equal to zero,

where *c* is an integer less than or equal to five and greater than or equal to zero,

where the sum of *a*, *b*, and *c* is equal to six,

where X is a halogen, and

where R is an alkyl group.

10. The method of claim 2, wherein pre-mixing further comprises adding the halogen substituted silicon hydride and the nitrogen-containing precursor to an organic solvent.

11. The method of claim 10, wherein the silicon source is selected from the group consisting of linear silazanes, branched silazanes, partially substituted aminosilanes with diamene ligands, fully substituted aminosialnes with diamene ligands, silyl cyclopropane, silyl cyclobutane, and halogenated aminosilanes.

12. The method of claim 10, wherein the nitrogen source is selected from the group consisting of dimethyl hydrazine, methyl hydrazine, and asymmetrical dimethyl hydrazine.

13. A method, comprising:

adding a silicon precursor and a nitrogen-containing precursor to a deposition chamber;

exposing the silicon precursor and the nitrogen-containing precursor to electromagnetic waves having a wavelength of about 10 nanometers to about 1 millimeter; and

applying thermal energy to the silicon precursors and the nitrogen-containing precursor.

14. The method of claim 13, further comprising;

setting an operating temperature of the deposition chamber below 550 ^{0}C; and

providing a substrate within the deposition chamber, wherein the silicon precursor and the nitrogen-containing precursor form a silicon nitride layer on the substrate.

15. The method of claim 14, wherein exposing further comprises applying ultraviolet light having a wavelength of about 10 nanometers to about 700 nanometers.

16. The method of claim 14, wherein exposing further comprises reacting a silyl-cyclobutane with the nitrogen-containing precursor.

17. The method of claim 14, wherein exposing further comprises reacting a silyl-cyclopropane with the nitrogen-containing precursor.

18. The method of claim 15, wherein adding further comprises passing the silicon precursor and the nitrogen-containing precursor through a distributor coupled to the deposition chamber.

19. The method of claim 15, wherein the silicon precursors and the nitrogen-containing precursors are exposed to ultraviolet light prior to setting the operating temperature of the deposition chamber.

20. The method of claim 18, wherein the silicon precursors and the nitrogen-containing precursors are exposed to ultraviolet light while passing through the distributor and before entering the deposition chamber.

21. An apparatus, comprising:

a deposition chamber having a top and a bottom;

a distributor disposed near the top of the deposition chamber;

a heater coupled to the deposition chamber; and

an electromagnetic wave source coupled to the deposition chamber, the electromagnetic wave source to deliver waves having a wavelength of about 10 nanometers to about 700 nanometers.

22. The apparatus of claim 21, wherein the electromagnetic wave source comprises ultraviolet energy.

23. The apparatus of claim 22, wherein the heater provides an operating temperature of less than 550 ^{0}C to deposit a silicon nitride layer on a substrate disposed within the deposition chamber.

24. The apparatus of claim 23, further comprising a second chamber coupled to the deposition chamber, the second chamber to contain a silicon precursor and a nitrogen precursor.

25. The apparatus of claim 21, wherein the heater is disposed around the chamber, and wherein the electromagnetic wave source is integrated within the heater.

26. The apparatus of claim 21, wherein the distributor comprises a showerhead, and wherein the electromagnetic wave source is disposed near the showerhead.

27. The apparatus of claim 21, wherein the electromagnetic wave source is disposed near the bottom of the deposition chamber.